MA Thesis – Human Skeletal Biology Track, Physical Anthropology – New York University (2017)

COMPARATIVE TRABECULAR MICROARCHITECTURE OF THE NAVICULAR ACROSS EXTANT PRIMATE SPECIES

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Abstract

The evolution of bipedalism has received a great deal of attention in the study of human origins because it is one of the earliest divergences that occurred between chimpanzee and human lineages. Studying the functional morphology of fossil hominins has led to many hypotheses about the specific changes in locomotor pattern that occurred throughout the evolution of bipedalism. The foot is a particularly useful structure to study because it makes direct contact with the substrate during locomotion. Significant modifications have evolved resulting in a human foot that is efficient for walking long distances. One of these crucial modifications is the longitudinal arch in the medial column of the foot. Within the longitudinal arch lies the navicular bone. The navicular is subjected to high forces during locomotion because it has an important role in transferring weight from the talar head to the rest of the foot. It is well known that trabecular bone responds to these types of forces by aligning with them and/or by increasing in bone volume.

This thesis investigates the trabecular microarchitecture of the navicular bone across a variety of extant primates in order to create a comparative sample with which fossil hominin naviculars may be compared to in the future. This is intended to assist in reconstructing locomotor patterns by gaining greater insight into the foot loading patterns throughout the evolution of bipedalism. In this study, I measured four variables of trabecular microarchitecture in *H. sapiens* (n=11), *Gorilla* (n=9), *Pan* (n=10), *Pongo* (n=4), *Hylobates* (n=1), *Ateles* (n=2), *Procolobus* (n=1), *Colobus* (n=1), and *Erythrocebus* (n=1). I calculated the bone volume, alignment, and trabecular strut thickness and spacing in four regions of interest across the bone. These regions of interest were irregular in shape and included trabeculae neighboring the cortical bone where the functional signal tends to be strongest.

My results indicate a unique amount of and shift in trabecular alignment in *H. sapiens* when compared to great apes. These differences correspond with the uniform loading observed in *H. sapiens*. Great apes exhibited greater bone volume and trabecular thickness which corresponds to their greater frequency and magnitude of force through the navicular. In addition, the navicular tuberosity, which contacts the ground in great apes but not in *H. sapiens*, reflects that difference through greater alignment and bone volume in the great apes within that region of the bone. Because these results are congruent with the known functional differences between these taxa, these results may serve as a useful comparative dataset for fossil hominin naviculars to provide insights into their relative loading patterns during locomotion.